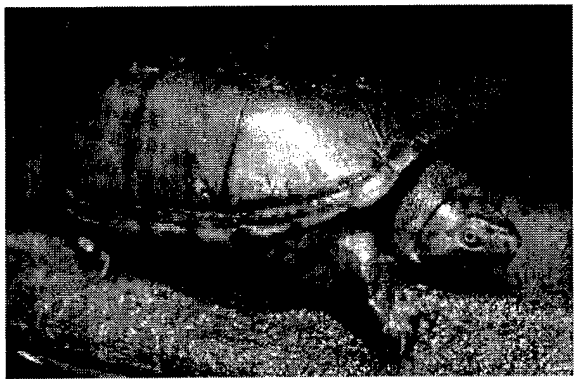
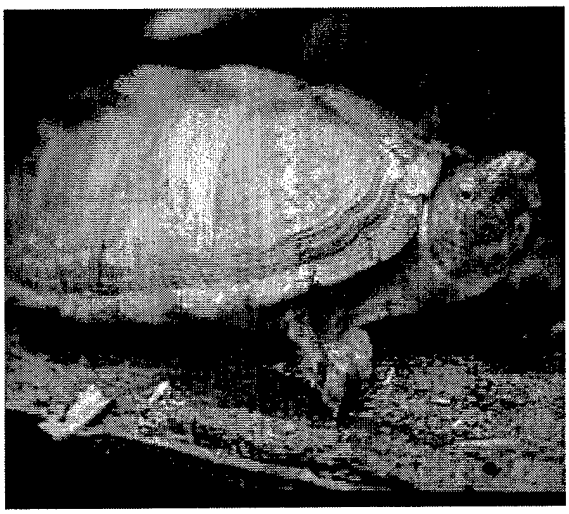
Technical Note EMRRP-SI-07
April 1999

Mud and Musk Turtle Habitats Potentially Impacted by USACE Reservoir Operations



Mississippi Mud Turtle
photo by Dena Dickerson

BACKGROUND: Changing water levels or other operations at U.S. Army Corps of Engineers (USACE) reservoirs may impact critical habitat parameters for mud and musk turtle species. This technical note identifies mud and musk turtle species and habitats potentially impacted by USACE reservoir or other water-control projects as reported by resource managers (Table 1). Current state and/or Federal legal protection status is summarized (Figure 1, Table 2), as is the distribution of USACE Districts and reservoir projects potentially impacted by mud and musk turtle conservation issues. Life-history summaries and habitat requirement descriptions are given for each mud and musk turtle species identified as potentially impacted at reservoir operations. This group includes 10 species with legal protection in at least one state and one Federally threatened species. Three of these species are associated with environmental issues at 23 USACE projects from 1 USACE District.



Razorback Musk Turtle
photo by Dena Dickerson

The collective range for these 10 environmentally sensitive species is widespread throughout the central, southeastern, and Atlantic coastal regions of the United States (Figure 2). Mud and musk turtles are found in almost any quiet water within their range to include: swamps, wetlands, sinkholes, rivers, creeks, ponds, lakes, reservoirs, etc. Mud and musk turtles are placed in a separate group because of morphological and behavioral differences as well as the diversity of aquatic systems inhabited. Diet varies somewhat

Mud/Musk Turtles Potentially Impacted by Reservoir Operations

Turtle Common Name	Scientific Name	Protection Status
Yellow mud	*Kinosternon f. flavescens*	State protected
Illinois mud	*K. f. spooneri*	Candidate for Federal protection
Stinkpot	*Sternotherus odoratus*	State protected

geographically but the bulk of the mud and musk turtles' diet consists of aquatic invertebrates. Habitat destruction is mainly attributed to declines in mud and musk turtle populations.

Table 1
Summary of Survey Results, Mud/Musk Turtles

Species	Protection Status		Divisions Identified	Districts Identified	Number	
	State	Federal			District	Total
Illinois mud turtle	State protected		MVD	Rock Island	1?	1
Yellow mud turtle		Candidate for Federal protection	MVD	Rock Island	23	23
Stinkpot turtle	State protected		MVD	Rock Island	23	23
		Summary	MVD	Rock Island	23?	23

? Questions remain about survey response

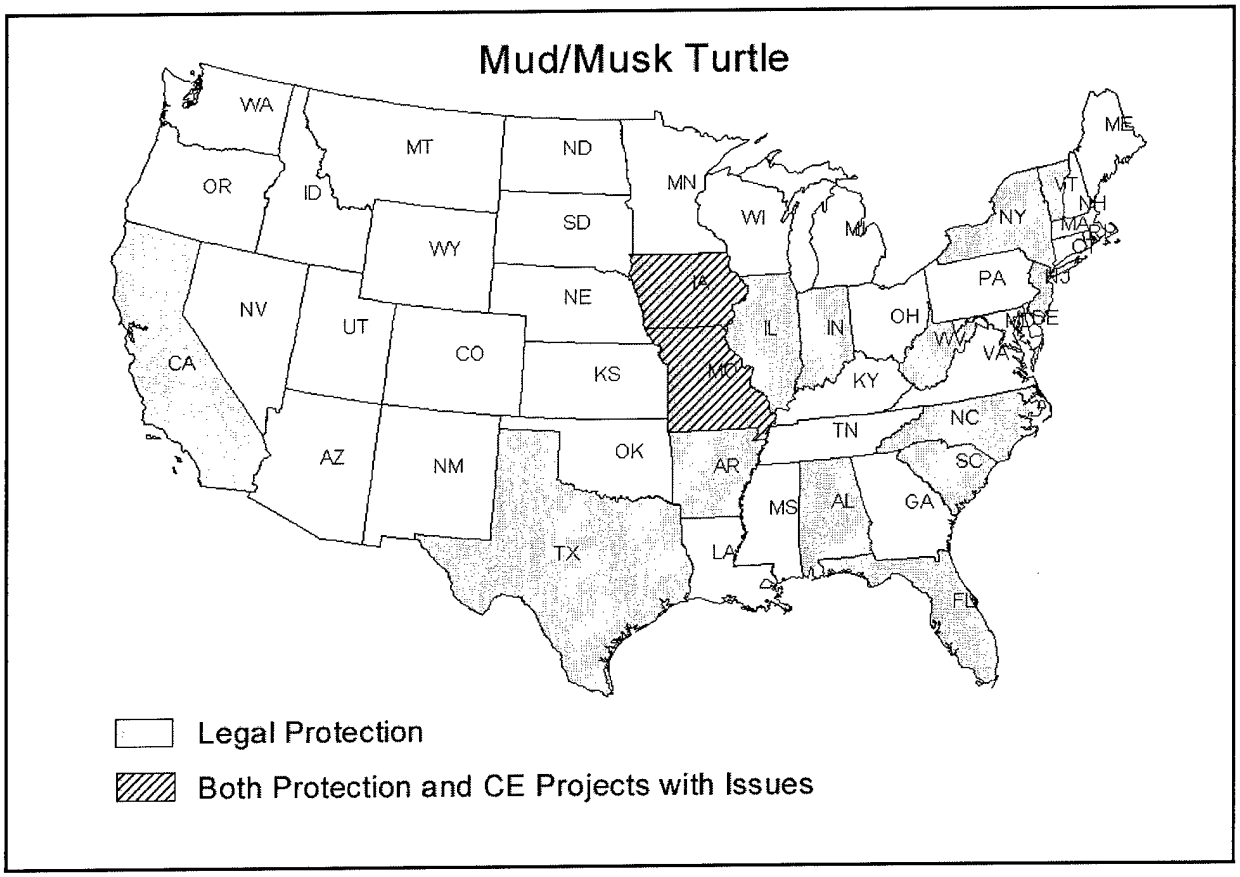


Figure 1. Legal protection status

Table 2
Turtle Protection Status by Species (Page 1)

States			Illinois Mud	Yellow Mud	Stinkpot Common Musk	Loggerhead Musk Turtle	Stripeneck Musk Turtle	Razorback Musk Turtle	Flattened Musk Turtle	Chihuahuan Mud Turtle	Sonoran Mud Turtle	Striped Mud Turtle	Eastern Mud Turtle
									FT				
Midwest	ID	9/97											
	MT	3/97											
	WY	1/97											
	CO	7/95											
	KS	6/93											
	NE	5/94											
	ND	97											
	SD	3/96											
Southwest	NM	12/97											
	AZ	1/97											
	NV	5/94											
	UT	3/97											
Pacific	CA	3/97									SSC		
	OR	12/96											
	WA	7/93											
	HI	1/97											
	AK	9/93											
Gulf	TX	11/97								T			
	LA	1/97											
	MS	6/96											
	AL	11/97							FT				
	OK	4/93											
	AR	6/96						SSC					
	TN	9/94											

FT Federally threatened
FC Federal candidate for protection
SSC State species of special concern
T or ST State threatened
E or SE State endangered
PHR Possession and/or harvesting regulations
Shading Indicates species with potential issues at CE reservoirs

Table 2 (Page 2)

States			Illinois Mud	Yellow Mud	Stinkpot Common Musk	Loggerhead Musk Turtle	Stripeneck Musk Turtle	Razorback Musk Turtle	Flattened Musk Turtle	Chihuahuan Mud Turtle	Sonoran Mud Turtle	Striped Mud Turtle	Eastern Mud Turtle
									FT				
North Central	KY	11/97											
	MO	6/97	E	E									
	IA	1/98	E		T								
	MN	7/96											
	WI	12/97											
	IN	4/97											E
	IL	94		FC	SE								
	OH	9/97											
	MI	6/94											
	WV	1/97			PHR								
North Atlantic	ME	1/95											
	NH	1/98											
	VT	3/98			SSC								
	MA	11/97											
	CT	95											
	RI	95											
	NY	2/97											SSC
	PA	1/94											
	NJ	6/96			SSC								SSC
	DE	3/97											
	MD	11/94											
	VA	5/92											
South Atlantic	NC	9/94					SSC						
	SC	1/98	SSC										SSC
	GA	10/97											
	FL	8/97				PHR						E	

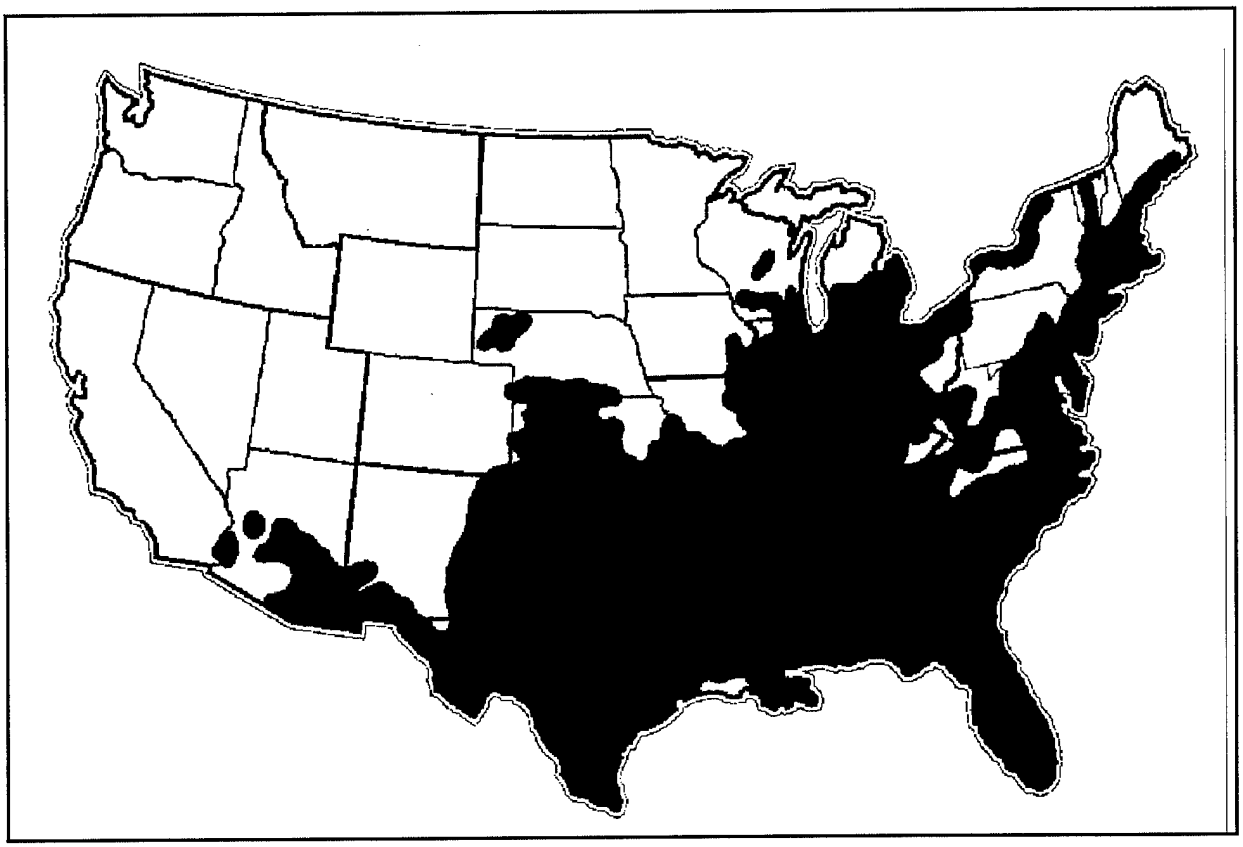


Figure 2. Mud/musk turtle habitat range

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Profile: Yellow mud turtle (*Kinosternon flavescens flavescens*)

Distribution. Range extends from northwestern Illinois, eastern Iowa, northeastern Missouri, and Nebraska south to Texas, New Mexico, and southeastern Arizona in the United States, and to the Rio Panuco Basin of Veracruz, Mexico. Populations in Illinois and adjacent Iowa and Missouri were formerly designated a separate race (*K. f. spooneri*, Smith (1951)), but studies by Houseal et al. (1982) and Berry and Berry (1983) synonymized it with *K. f. flavescens* (Dodd 1982, 1983; Bickham et al. 1984; Gallaway et al. 1985).

Habitat. Typically found in almost any quiet water within its range to include: swamps, sloughs, sinkholes, rivers, creeks, ponds (particularly temporary ones), lakes, reservoirs, cisterns, and cattle tanks in semiarid grasslands, open woodlands, or deserts (Ernst et al. 1994). Habitat characterized as having a mud or sand bottom with aquatic vegetation is preferred. In the northern part of its range, sandhill habitats allow it to dig below the frost line in winter.

Behavior. Activity varies geographically and lasts 183 days from 15 April to 15 October in New Mexico (Christiansen and Dunham 1972), 140 days in Oklahoma (Mahmound 1969), 100-128 days from late April to mid-July and then again from mid- to late August to September or October in Missouri and Iowa (Christiansen et al. 1985; Johnson 1987). A period of terrestrial estivation usually occurs in midsummer. Most activity is diurnal, but some limited nocturnal activity occurs from 1700 to 2000 hr. *K. f. flavescens* spends much of its time basking or moving on land, and it occasionally migrates overland between bodies of water. Hibernation occurs in natural depressions such as old stumpholes, and beneath shrubs, brushpiles, and logs. Burrowing in loose sandy soil is common (particularly in the northern portion of its range) or in muskrat dens or in the mud at the bottom of pools. They can remain terrestrially dormant for up to two years (Rose 1980). Male yellow mud turtles sometimes engage in aggressive behavior. Lardie (1983) suggests that this is an example of territoriality, with the dominant male defending small aquatic areas with its available food supply and any females within it.

Reproduction. Courtship usually takes place in water beginning in May and peaks in the first half of June. Nesting occurs in sparsely vegetated, generally south-facing slopes, at depths of 17-23 cm beneath the soil surface (Iverson 1990). Nests are dug initially by pushing sand laterally with the forelimbs and posteriorly with the hind limbs and excavation is completed with the hind limbs only. After eggs are deposited, the female remains with them for one to more than 38 days, and some females may not return to the water until the next spring. Females in most northern populations lay only one clutch per year, while southern populations may occasionally produce two clutches. Clutch size ranges from 1 to 9 eggs. Hatching occurs from August to October in most populations, but probably in July and August in southern Arizona. In Iowa the young hatch in mid-September but remain underground until the following spring (Christiansen and Gallaway 1984). In western Texas, hatchlings also seem to overwinter underground and emerge in early summer (Long 1986). Those in Nebraska hatch and then dig down to avoid frost (Iverson 1990). Lardie (1975, 1979) recorded incubation periods of 94-118 days for eggs incubated in the laboratory at 22-33 ^{o}C. Gender determination is temperature-dependent (Vogt and Bull 1982).

Food habits. Diet varies somewhat geographically. Iowa turtles feed on fish, crustaceans, insects (particularly beetles); and plant material (Christiansen et al. 1985). Nebraska yellow mud turtles feed mainly on snails, tadpoles, earthworms, and carrion (Iverson 1975); and in northeastern Missouri, snails, crayfish, fish, and plant material are the most prevalent foods (Kofron and Schreiber 1985). In Texas, planarians, nematodes, oligochaetes, isopods, crayfish, insects, and amphibians are consumed frequently; however, snails were eaten most often (Punzo 1974).

Populations. Most populations in Illinois were apparently small, and the yellow mud turtle has disappeared from several localities in that state since the 1950's (Brown and Moll 1979). Despite temperature-dependent gender determination, sex ratios in many locations are not significantly different from 1:1 (Iverson 1991a). Some studies indicate that survivorship from egg to hatchling emergence is only 19 percent (Iverson 1991b). Egg predation, egg infertility, overwintering mortality, and death during migration from the nest to the water are the prime reasons for low survivorship.

Remarks. *Protection status*: Endangered: Montana.

Profile: Stinkpot or common musk turtle (*Sternotherus odoratus*)

Distribution. Range extends from New England, Quebec, and southern Ontario south to Florida and west to Wisconsin and central Texas.

Habitat. The stinkpot occurs in almost any waterway with a slow current and soft bottom. This includes rivers, streams, lakes, ponds, sloughs, canals, swamps, bayous, and oxbows. The fall line may limit the distribution of the stinkpot, which is found only above it in rivers draining into the Gulf of Mexico (Tinkle 1959). Conant and Bailey (1936) reported that stinkpot turtles are not tolerant of brackish waters.

Behavior. In Florida and south-central Texas, stinkpot turtles may be active all year long (Vermersch 1992), but farther north, stinkpots are usually forced to hibernate in winter. Activity varies geographically from about 200 days (April to October) in southeastern Pennsylvania to 330 days in Oklahoma. Stinkpots are typically nocturnal (Ernst 1986). During the daylight hours they are generally inactive, remaining buried in the mud or resting on the bottom. Because it spends extended periods underwater, the stinkpot often has a rich growth of algae and many leeches on its shell (Reilly 1983; Ernst 1986). The basking habit is poorly developed and is rarely found out of water. Most basking occurs while the turtle rests in shallow water with only the top of its carapace exposed to the sunlight. It may, however, climb onto the river bank or onto fallen trees to bask. Older turtles drop into the water when disturbed but younger ones hold on with such a grip that it is sometimes difficult to remove them. In Pennsylvania, most basking takes place from April to July (Ernst 1986). Hibernation occurs when water temperatures fall below 10 ^{o}C, prompting turtles to bury themselves 30 cm in the mud bottom underwater, beneath rocks, logs, or detritus in or near the water, in recesses beneath banks, or in muskrat dens or lodges. Williams (1952) reported site fidelity by stinkpots when homing ability was studied. Stinkpots occasionally move overland, but home range is probably confined to one body of water. Newly emerged hatchlings find their way from the nest to the water primarily through the attraction of large areas of intense illumination.

Reproduction. Courtship and mating occur sporadically throughout the year, with peaks in spring and fall. Most mating occurs in April and May (Ernst 1986). A second period of mating occurs in September and October but may extend into December. The nesting season varies with latitude: in the south, egg-laying lasts from February through July, in south central Texas, from April through July, and in the north, from May through July. Nesting may occur from early morning into the night, although Ernst (1986) reported most nesting occurred in the evening (1910-2048 hr). Egg-laying, which usually occurs near the water, may occur on the open ground, or within well-formed nests as deep as 10 cm. Eggs are frequently deposited under stumps, fallen logs, and in the walls of muskrat lodges (Ernst et al. 1994). Nests are usually dug with the hind limbs only and female stinkpots will frequently share the nest with other stinkpot turtles. McPherson and Marion (1981, 1983) reported that as many as 3 to 4 clutches containing 1 to 9 eggs may be laid in a season. Natural incubation ranges from 65 to 86 days, and hatchlings emerge from August to November depending on latitude. Some overwintering has been reported in South Carolina (Gibbons 1970) but not in other locations such as Pennsylvania (Mitchell 1988).

Food habits. Stinkpots under 5 cm in carapace length feed predominantly on small aquatic insects, algae, and carrion, whereas those above 5 cm feed on anything available. The stinkpot is known to eat earthworms, leeches, clams, snails, crabs, crayfish, aquatic insects, fish eggs, minnows, tadpoles and adult frogs, algae, and parts of higher plants. Newman (1906) observed stinkpots crawling about on land, at dusk, feeding on slugs.

Populations. Some studies has shown population densities ranged from 24 turtles per hectare in Pennsylvania (Ernst 1986) to 194 turtles per hectare in Virginia (Mitchell 1988). Most populations are composed predominantly of adults. Ernst (1986) reported that adults make up over 70 percent of a population studied in Pennsylvania. In an Alabama lake, Dodd (1989) reported juveniles made up only 16.3 percent of captured turtles. Most studies show sex ratios of males to females at or near 1:1 (Bancroft et al. 1983).

Remarks. *Protection status*: Threatened: Idaho; State species of special concern: Vermont, New Jersey; Possession and/or harvesting regulations: West Virginia.

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